

PER, BV, DIGESTIBILITY AND NPU

Nutrients Substances obtained from food that provide nourishment



Macronutrients

Micronutrients



Energy producing

Protective



Carbohydrates, fats, proteins

Vitamins, minerals

Nutritive value of protein

- Necessary for building and repairing of body tissues
- Act as transport nutrients
- Act as enzymes and hormones
- Supply 4Kcal/ g energy
- Help in recovering from infections and diseases (strengthen immune system)
- 34-56 g/ day, depending upon age and sex
- During pregnancy and lactation it is 71 g/ day
- Fish – 20 to 60 % depend on the age and size of specie(also quality)

Fat

- Supply energy 9 Kcal/g
- Essential for absorption of fat soluble vitamins such as
- vitamin A, D, E, K

Assessment of nutritional value of proteins

- ① **Protein efficiency ratio (PER)**
- ① **Biological value (BV)**
- ① **Net protein utilization (NPU)**
- ① **Chemical score**

Protein efficiency ratio (PER)

- ◎ **PER is represented by gain in the weight of rats per gram protein ingested.**

$$\text{PER} = \frac{\text{Gain in body weight (g)}}{\text{Protein ingested (g)}}$$

Biological Value (BV)

- ⊙ **BV is defined as the percentage of absorbed nitrogen retained by the body**

$$BV = \frac{\text{Nitrogen retained}}{\text{Nitrogen absorbed}} \times 100$$

- ⊙ **BV can be calculated by the following formula:**

$$BV = \frac{(\text{N absorbed} - \text{N lost in metabolism})}{\text{N absorbed}} \times 100$$

Net protein utilization (NPU)

- ⊙ **NPU is a better nutritional index than biological value.**
- ⊙ **Net protein utilization can be calculated as:**

$$\text{NPU} = \frac{\text{Nitrogen retained}}{\text{Nitrogen absorbed}} \times 100$$

Chemical score

- ◉ This is based on the chemical analysis of protein for composition of essential amino acids which is then compared with a reference protein (egg protein).
- ◉ The chemical score is defined as the ratio between the quantity of the most limiting essential amino acid in the test protein to the quantity of the same amino acid in egg protein.

$$\text{Chemical score} = \frac{\text{Mg of limiting amino acid/g test protein}}{\text{Mg of same amino acid/g egg protein}} \times 100$$

Nutritional value of food proteins

Protein	PER	BV	NPU	Chemical score	Limiting AAs
Egg	4.5	94	90	100	Nil
Milk	3.0	84	75	65	Sulfur AAs
Fish	3.0	85	70	60	Tryptophan
Meat	2.7	75	76	70	Sulfur AAs
Rice	2.2	68	60	60	Lys. threonine
Wheat	1.5	58	47	42	Lys. threonine
Bengal gram	1.7	58	47	45	Sulfur AAs

Digestibility

- Quantification of the digestive processes
- It is relative measure of the extent to which ingested food and its nutrient component have been digested and absorbed by animal
- The total and dry matter digestibility refers to the degree of digestibility of the complete diet
- Nutrient digestibility refers to a specific nutrient such as protein, lipid, amino acid or carbohydrate of the diet and or the ingredient
- Aquaculture point of view knowledge of digestibility is important Method of evaluation of digestibility and of influence of age sex, stocking density, time and frequency of feeding and feed quality and quantity of culturable species is more important
- The nutritive value of a food depends not only on its nutrient content but also on the capacity of the animal to digest and absorb it

Digestibility coefficient-

Coefficient of digestibility the proportion of a food that is digested compared to what is absorbed, expressed as a percentage.

The objective of digestibility study

- A better understanding of the potential utilization of nutrients
- An improvement in quality of food for the fish
- decrease in the waste of food & protecting the environmental & Water quality

Method

- **Direct method-** the quantity ingested (total or nutrient) and faecal matter voided are determined and the ratio gives the percentage digestibility of the feed or nutrient.
- It is difficult to determine total faecal matter accurately
- Leaching of nutrient from faecal matter and collection of faecal matter which break up into small particle
- Automatic continuous faecal collection devices use for collection of faecal matter

Error due to leaching and re-ingestion of faecal matter

Indirect method First use by Swedish scientist Edin 1918 he use marker

- Characteristic of marker – Indigestible, use small quantity, distributed evenly in test diet or an indigestible component of diets
- Marker should not influence the physiology of digestion of experimental animal
- Should move into the gut at the same rate as the rest of the food material
- should not to be toxic

Two types of marker – internal and external marker

- Commonly use external marker –these are introduced into the diet Cr₂O₃; FeO; SiO₂; polypropylene etc
- Most commonly use external marker is Cr₂O₃
- Internal marker of Endogenous – commonly used for digestibility study are crude (CF), Hydrolysed resistance organic matter(HROM) and Hydrolysed resistance ash(HRA)

DIGESTIBILITY COEFFICIENTS

ADC

It allows the quantification of digestibility

TDC

$\text{ingested} - \text{faecal} / \text{ingested} * 100$

$\text{ingested} - (\text{faecal} - \text{endogenous faecal}) / \text{ingested} * 100$

Depends physiological state of fish & ingestion rate, allows aptitude animal to utilise a food ration to be evaluated

Mainly ADC, endogenous fraction which is low in fishes & difficult.

Depends mainly on type of diet & digestive capacity of the species, allows evaluation of suitability of a food to provide animal utilisable nutrients.

Indirect method

$$\text{ADC} = 100 - (100 * \% \text{ marker in food} / \% \text{ marker in faeces})$$

$$\text{The digestibility of nutrient} \\ = 100 - (100 * \% \text{ marker in food} / \% \text{ marker in faeces} * \% \text{ nutrient in} \\ \text{faeces} / \% \text{ nutrient in food})$$

crude fibre(CF), Hydrolysis-resistant
organic matter(HROM), and
hydrolysis-resistance ash(HRA)

Cr_2O_3 , FeO, SiO_2 ,
polypropylene

Factor influence the digestibility

- Feeding level and meal size
 - Size of species and age
 - Dietary component
 - Types of nutrient
- Physical state of feed
 - Temperature
 - Salinity
- Protein energy ratio

Pepsin digestibility

The rate of digestion and the percentage of food that is absorbed into the body by **pepsin** is known as **pepsin digestibility**.

Role of fiber in human nutrition

- High-**fiber diets** tend to have more volume and less calories than other types of **diets**.
- In addition to promoting regularity, **fiber** lowers the risk of developing many life threatening diseases and conditions, such as heart disease, certain forms of cancer, diabetes, stroke and obesity

Prevents constipation

Fiber helps to maintain the normal motility of gastrointestinal tract (GIT) & prevents constipation

Eliminates bacterial toxins

Fiber adsorbs large quantities of water & also the toxic compounds produced by intestinal bacteria that lead to increased fecal mass & its easier expulsion

Improves glucose tolerance

Fiber improves glucose tolerance by the body

This is mainly done by a reduced the rate of glucose absorption from the intestine

Reduces plasma cholesterol level:

- Fiber decreases the absorption of dietary cholesterol from the intestine
- Fiber binds with the bile salts & reduces their enterohepatic circulation

Causes increased degradation of cholesterol

The harmful effects are mostly observed in

- people consuming large quantities of dietary fiber Digestion & absorption of protein are adversely affected
- The intestinal absorption of certain minerals (e.g. Ca, P, Mg) is decreased
- Intestinal bacteria ferment some fibers causing flatulence(gas formed in the stomach) & often discomfort